

**AMENDMENTS TO THE CLAIMS:**

This listing of claims will replace all prior versions of claims in the application.

**LISTING OF CLAIMS:**

Claims 1–19: (Cancelled).

**[Claim 20]** (New): A photonic waveguide comprising of:

a substrate,  
a first layer of a nanomaterial,  
a second layer of a nanomaterial,  
a third layer of the first nanomaterial,  
a fourth layer of an optical material,  
wherein the second layer has a higher refractive index than the first layer,  
wherein the third layer has the same refractive index as the first layer,  
wherein the first layer is the bottom cladding,  
wherein the second layer is the guiding layer,  
wherein the third layer is the top cladding,  
wherein the fourth layer is a cover layer,  
wherein the second layer is patterned to form the core of the waveguide,  
wherein the first and the third layers enclose the second layer, thus forming a waveguide,  
wherein the waveguiding is accomplished by the natural index contrast (NIC) method where the NIC value is given by

$$\Delta n = \frac{n_2 - n_1}{n_1} \times 100 ,$$

wherein  $n_1$  is the refractive index of cladding layer and  $n_2$  is the refractive index of the core layer,  
wherein the NIC value has a range of  $>0\%$  to  $\sim 240\%$ ,  
wherein the guiding layer also has the ability to amplify an optical signal, thus, an amplifying layer,  
wherein the guiding layer also has the ability to modulate an optical signal, thus a modulating layer,  
wherein the guiding layer is doped with at least a first dopant to amplify an optical signal,  
wherein the guiding layer is also doped with at least a second dopant to modulate an optical signal.

**[Claim 21]** (New): The waveguide of claim 20 wherein the waveguide can transmit light at least in the wavelength range of 1060 to 1650 nm.

**[Claim 22]** (New): The waveguide of claim 20 wherein the first layer comprises of a nanomaterial that is deposited on the said substrate by at least one method from spin-coating, spray deposition, chemical vapor deposition, etc.

**[Claim 23]** (New): The waveguide of claim 20 wherein the second layer comprises of a nanomaterial that is deposited on top of the said first layer of Claim 22 by at least one method from spin-coating, spray deposition, chemical vapor deposition, etc.

**[Claim 24]** (New): The waveguide of claim 20 wherein the first layer is at least a dendrimer, a spin-on-glass, a nanosilica, a polymer, or a composition thereof.

**[Claim 25]** (New): The waveguide of claim 20 wherein the second layer is at least a dendrimer, a spin-on-glass, nanosilica, a polymer, or a composition thereof.

**[Claim 26]** (New): The waveguide of claim 20 wherein the thickness of the first layer is controlled at least by solution concentration, solution viscosity, solution pH, spin-coating parameters, and curing parameters.

**[Claim 27]** (New): The waveguide of claim 20 wherein the thickness of the second layer is controlled at least by solution concentration, solution viscosity, solution pH, spin-coating parameters, and curing parameters.

**[Claim 28]** (New): The waveguide of claim 20 wherein the patterned second layer comprises of a plurality of waveguides.

**[Claim 29]** (New): The waveguide of claim 20 wherein the second layer is comprised of at least one waveguide structure from a group of waveguide structures comprising of: linear waveguide, curved waveguide, circular waveguide, splitter, spiral waveguide, serpentine waveguide, branched waveguide, slab waveguide, parallel waveguide, converging waveguide, diverging waveguide, and interconnect waveguide.

**[Claim 30]** (New): The waveguide of claim 20 wherein the patterned second layer defines at least one device.

**[Claim 31]** (New): The waveguide of claim 20 wherein the substrate material comprises of at least one hard and non-flexible material from the group: silicon, glass, quartz, plastic, alumina, and ceramic.

**[Claim 32]** (New): The waveguide of claim 20 wherein the substrate material comprises of at least one soft and flexible material from the group: plastic, polyimide, pyrex, and polymer.

**[Claim 33]** (New): A photonic waveguide comprising of:

- a substrate,

- a first layer of a nanomaterial,

- a second layer of a nanomaterial,

- a third layer of the first nanomaterial,

- a fourth layer of an optical material that forms a cover layer,

- wherein the second layer having the ability to amplify an optical signal,

- wherein the second layer has a higher refractive index than the first layer,

- wherein the third layer has the same refractive index as the first layer,

wherein the first layer is the bottom cladding,  
wherein the third layer is the top cladding,  
wherein the first and the third layers enclose the second layer, thus forming a waveguide,  
wherein the waveguide satisfies the NIC requirements,  
wherein the second layer is an amplifying layer,  
wherein the second layer is patterned to form the waveguide core, and pumped by a pump laser,  
wherein the waveguide can amplify light at least in the wavelength range of 1060 to 1650 nm,  
wherein the amplification wavelength range is tuned by choosing at least one rare-earth dopant species,  
wherein the amplification efficiency is tuned at least by the concentration of the rare-earth metal ion incorporation in the second layer.

**[Claim 34]** (New): The waveguide of claim 33 wherein the pump and the signal are combined at least via a coupler.

**[Claim 35]** (New): The waveguide of claim 33 wherein the first layer is at least a dendrimer, spin-on-glass, nanosilica, polymer, or a composition thereof.

**[Claim 36]** (New): The waveguide of claim 33 wherein the second layer is at least a dendrimer, a spin-on-glass, a nanosilica, a polymer, or a composition thereof.

**[Claim 37]** (New): The waveguide of claim 33 wherein the second layer is incorporated with at least one rare-earth metal ion from a group comprising of: Erbium, Neodymium, Praseodymium, Thorium, Holmium, Terbium, Europium, and other rare-earth metal ions with a dendrimer.

**[Claim 38]** (New): The waveguide of claim 33 wherein the patterned second layer comprises of a plurality of waveguides.

**[Claim 39]** (New): The waveguide of claim 33 wherein the second layer is comprised of at least one waveguide structure from a group of waveguide structures comprising of: linear waveguide, curved waveguide, circular waveguide, splitters, spiral waveguide, serpentine waveguide, branched waveguide, slab waveguide, parallel waveguide, converging waveguide, diverging waveguide, and interconnect waveguide.

**[Claim 40]** (New): The waveguide of claim 33 wherein the patterned second layer defines at least one device.

**[Claim 41]** (New): The waveguide of claim 33 wherein the substrate material comprises of at least one hard and non-flexible material from the group: silicon, glass, quartz, plastic, alumina and ceramic.

**[Claim 42]** (New): The waveguide of claim 33 wherein the substrate material comprises of at least one soft and flexible material from the group: plastic, polyimide, pyrex, and polymer.

**[Claim 43]** (New): A photonic waveguide comprising of:

- a substrate,

- a first layer of a nanomaterial,

- a second layer of a nanomaterial,

- a third layer of the first nanomaterial,

- a fourth layer of an optical material that forms a cover layer,

- wherein the second layer having the ability to modulate an optical signal via increased electro-optic coefficient,

- wherein the second layer has a higher refractive index than the first layer,

- wherein the third layer has the same refractive index as the first layer,

- wherein the first layer is the bottom cladding,

- wherein the third layer is the top cladding,

- wherein the first and the third layers enclose the second layer, thus forming a waveguide,

wherein the waveguide satisfies the NIC requirements,  
wherein the second layer is patterned to form the core of the waveguide,  
wherein the second layer is a modulating layer,  
wherein the waveguide can modulate light at least in the wavelength range of 1060 to 1650 nm.

**[Claim 44]** (New): The waveguide of claim 43 wherein the first layer is at least a dendrimer, a spin-on-glass, a nanosilica, a polymer, or a composition thereof.

**[Claim 45]** (New): The waveguide of claim 43 wherein the second layer is at least a dendrimer, a spin-on-glass, a nanosilica, a polymer, or a composition thereof.

**[Claim 46]** (New): The waveguide of claim 43 wherein the second layer is doped with at least one inorganic additive.

**[Claim 47]** (New): The waveguide of claim 43 wherein the second layer is doped with at least one organic additive such as a chromophore.

**[Claim 48]** (New): The waveguide of claim 43 wherein the patterned second layer comprises of a plurality of waveguides.

**[Claim 49]** (New): The waveguide of claim 43 wherein the second layer is comprised of at least one waveguide structure from a group of waveguide structures comprising of: linear waveguide, curved waveguide, circular waveguide, splitters, spiral waveguide, serpentine waveguide, branched waveguide, slab waveguide, parallel waveguide, converging waveguide, diverging waveguide, and interconnect waveguide.

**[Claim 50]** (New): The waveguide of claim 43 wherein the patterned second layer defines at least one device.

**[Claim 51]** (New): The waveguide of claim 43 wherein the substrate material comprises of at least one hard and non-flexible material from the group: silicon, glass, quartz, plastic, alumina and ceramic.

**[Claim 52]** (New): The waveguide of claim 43 wherein the substrate material comprises of at least one soft and flexible material from the group: plastic, polyimide, pyrex, and polymer.

**[Claim 53]** (New): The waveguide of claim 20 wherein the thickness of the third layer is controlled at least by solution concentration, solution viscosity, solution pH, spin-coating parameters, and curing parameters.

**[Claim 54]** (new): A photonic integrated circuit (PIC), comprising:

- a first layer of nanomaterial with a first refractive index;

- a second layer of nanomaterial with a second refractive index, wherein the second refractive index is greater than the first refractive index; and

- a third layer of nanomaterial with a third refractive index, wherein the third refractive index is substantially the same as the first refractive index;

- wherein waveguides are used as a building block for the PIC;

- wherein the waveguides, forming the building blocks of the PIC, satisfies the NIC requirements.

**[Claim 55]** (New): The photonic integrated circuit of claim 53, wherein the second layer is a guiding layer.

**[Claim 56]** (New): The photonic integrated circuit of claim 53, wherein the guiding layer is doped for signal amplification.

**[Claim 57]** (New): The photonic integrated circuit of claim 53, wherein the guiding layer is doped for signal modulation.

**[Claim 58]** (New): The photonic integrated circuit of claim 53, wherein the guiding layer has a dopant.